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### COMPLETE SPECIFICATION.

#### Improvements in or relating to Low Pressure Gas or Vapour-Filled Positive Column Electric Discharge Lamps.

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British Company, and DEREK CHARLES PEACH, of Research Laboratories, The General Electric Company Limited, Wembley, Middlesex, a British Subject, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to low pressure gas or vapour-filled positive column electric discharge lamps of the type adapted for operation on alternating current supplies and the electrodes of which each consists of one or more refractory metal filaments coated with electron emissive material and mounted between a pair of support conductors which extend from and are themselves supported by the envelope of the device. The invention relates more particularly, though not exclusively, to low pressure mercury vapour fluorescent electric discharge lamps of this type, now popularly known simply as fluorescent lamps.

In known lamps of the type specified the support conductors usually consist of stout metal wires set into the pinched end of a glass foot-tube closing the lamp envelope and are each continued by a length of thinner sealing wire, such as "red platinum", sealed to the glass of the pinch, the sealing wire being in turn continued outside the envelope by a length of stouter wire forming a supply lead; the supply leads may in some cases be connected to separate terminals of a cap attached to the lamp envelope or may in other cases be twisted together and attached to a single terminal of such a cap.

In operation of a lamp of the type specified each electrode acts as a cathode during one half cycle of the supply voltage and as an anode during the other half cycle. When

acting as an anode the electrode is subjected to bombardment by the discharge and in known lamps adapted to operate at a relatively high current density, for example 0.85 amps or more, special pieces of sheet metal, known as anode plates, are usually attached to the wires supporting the electrode filaments in order to reduce the current density at the surface of the electrode and thereby reduce the rate of sputtering of metal from the electrode. In the absence of such plates the current at which the lamp can be operated without giving rise to undue sputtering may be undesirably limited.

The necessity for providing such anode plates and the work involved in attaching them to the support wires adds to the cost of the electrode assembly, and hence of making the lamp, and the object of this invention is to provide a form of electrode assembly in a lamp of the type specified by means of which the need for such anode plates can be obviated.

According to the invention in a lamp of the type specified at least one of the support conductors for each electrode is of substantially flat strip form for at least the greater part of its length within the lamp envelope.

Preferably each support conductor of each electrode is formed with a strip part of the kind aforesaid.

It will be appreciated that the statement that a support conductor is of substantially flat strip form for at least the greater part of its length necessarily implies that the said strip is an integral part of the conductor, and that a composite support conductor consisting of a strip part and one or more other parts secured together, for example by welding, is not included within the scope of the present invention.

By virtue of the increased anode area provided by the strip part of the support con-

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ductors, a lamp in accordance with the invention can be operated at a higher current density without giving rise to undue sputtering than can a lamp of the known kind exactly similar except in that it is provided with support conductors of circular cross-section, and by making the strip parts of sufficiently great surface area, the need for separate anode plates can be obviated for any lamp of the type specified.

For a lamp in accordance with the invention adapted to carry a discharge current of about 0.85 amps in normal operation, the combined total surface area of the support conductors for each electrode, including the strip parts, should be not less than about 80 square millimetres.

The whole of the support conductor may be formed of strip metal, or a strip part may be produced in a circular section wire conductor by flattening part of the wire, for example by rolling.

The support conductors which include the anode-forming strip parts in accordance with the invention are preferably composed of nickel, iron or nickel-iron alloy. If desired, for avoiding an undue length of support conductor projecting within the lamp envelope along its axis, the electrode filament(s) may be attached to an intermediate point along the strip part and the excess length of strip bent back to a suitable shape, for example extending laterally from its point of attachment to the filament.

One form of electrode assembly for a lamp in accordance with the present invention is shown in the drawing accompanying the Provisional Specification, and will now be described by way of example.

The drawing shows a perspective view of an electrode assembly mounted on a pinched glass foot-tube for sealing into the end of the tubular glass envelope of a fluorescent lamp 5 feet in length containing mercury together with a low pressure filling of rare gas for facilitating starting, and adapted to dissipate 80 watts in operation and to carry a discharge current of 0.85 amp.

Two composite supply conductors are sealed through the glass pinch 1 of the foot-tube, and are connected to the ends 3, 4 of a filamentary electrode 2 consisting of a coil of coiled tungsten wire coated with alkaline earth metal oxide. Each supply conductor consists of a length of copper wire 5, a short length of red platinum (i.e. copper-coated nickel-iron wire) 6 sealed to the glass within the pinch, and a nickel strip 7, the three parts of each conductor being welded together. The nickel strips 7 constitute what have been termed the support conductors carrying the electrode within the lamp envelope, and these strips provide the anode members of the electrode assembly; the strips are bent over the ends 3, 4 of the

electrode 2 so as to grip them firmly and the free ends 8 of the strips are bent so as each to extend in a direction approximately at right angles to the rest of the strip. The strips 7 are each of total length 20 mms., with 1.5 mms. and thickness 0.2 mms. and the total surface area of the two nickel strips together is about 130 square millimetres.

What we claim is:—

1. A low pressure gas or vapour filled positive column electric discharge lamp of the type specified, wherein at least one of the support conductors for each electrode is of substantially flat strip form for at least the greater part of its length within the lamp envelope.

2. A lamp according to Claim 1 wherein each support conductor of each electrode is of substantially flat strip form for at least the greater part of its length within the lamp envelope.

3. A lamp according to Claim 1 or 2 which is adapted to carry a discharge current of about 0.85 amps. in normal operation, wherein for each electrode the combined total surface area of the support conductors for the electrode is not less than 80 square millimetres.

4. A lamp according to Claim 1, 2 or 3 wherein each said support conductor is formed wholly of strip metal.

5. A lamp according to Claim 1, 2 or 3 wherein at least one support conductor is formed of circular section wire provided with a strip part by flattening part of the wire.

6. A lamp according to any preceding claim wherein the said support conductors, including the strip parts, are composed of nickel or iron or a nickel-iron alloy.

7. A lamp according to any preceding claim wherein each said strip part of a support conductor is attached to the electrode filament(s) at an intermediate point along the length of the strip, and the length of strip extending beyond said point of attachment is bent so as to extend laterally from the rest of the strip.

8. A low pressure gas or vapour filled positive column electric discharge lamp of the type specified wherein each electrode assembly is of the form shown in and hereinbefore described with reference to the drawing accompanying the Provisional Specification.

For the Applicants,  
J. E. M. HOLLAND,  
Chartered Patent Agent.

## PROVISIONAL SPECIFICATION.

## Improvements in or relating to Low Pressure Electric Discharge Lamps.

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British Company, and DEREK CHARLES PEACH, of Research Laboratories, The General Electric Company Limited, Wembley, Middlesex, a British Subject, do hereby declare this invention to be described in the following statement:—

10 This invention relates to low pressure electric discharge lamps of the type adapted for operation on alternating current supplies and the electrodes of which each consists of one or more refractory metal filaments  
15 coated with electron emissive material and mounted between a pair of support conductors which are themselves supported from the envelope of the device. The invention relates more particularly, though not exclusively,  
20 to low pressure mercury vapour fluorescent electric discharge lamps of this type, now popularly known simply as fluorescent lamps.

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In operation of a lamp of the type specified each electrode acts as a cathode during one half cycle of the supply voltage and as an anode during the other half cycle. When acting as anode the electrode is subjected to bombardment by the discharge and in known lamps adapted to operate at a relatively high current density, for example 0.85 amps or more, special pieces of sheet metal, known as anode plates, are usually attached to the wires supporting the electrode filaments in order to reduce the current density at the surface of the electrode and thereby reduce the rate of sputtering of metal from the electrode. In the absence of such plates the current at which the lamp can be operated without giving rise to undue sputtering may be undesirably limited.

The necessity for providing such anode plates and the work involved in attaching them to the support wires adds to the cost

of the electrode assembly, and hence of making the lamp, and the object of this invention is to provide a form of electrode assembly in a lamp of the type specified by means of which the need for such anode plates can be obviated.

According to the invention in a lamp of the type specified at least one of the support conductors for each electrode has for at least the greater part of its length the form of a strip whose total surface area is considerably greater than that of a similar length of circular-section wire of the same cross-sectional area.

By virtue of the increased anode area provided by the strip part of the support conductors, a lamp in accordance with the invention can be operated at a higher current density without giving rise to undue sputtering than can a lamp of the known kind exactly similar except in that it is provided with support conductors of circular cross-section, and by making the strip parts of sufficiently great surface area, the need for separate anode plates can be obviated for any lamp of the type specified.

For a lamp in accordance with the invention adapted to carry a discharge current of about 0.85 amps in normal operation, the total surface area of the support conductors for each electrode, including the strip parts, should be not less than about 80 square millimetres.

Preferably each said support conductor is formed in one piece with the strip part integral therewith; for example the whole of the support conductor may be formed of strip metal, or a strip part may be produced in a circular section wire conductor by a local flattening thereof, for example by rolling.

Preferably each support conductor of each electrode is formed with a strip part of the kind aforesaid.

The support conductors which include the anode-forming strip parts in accordance with the invention are preferably composed of nickel, iron or nickel-iron alloy. If desired, for avoiding an undue length of support conductor projecting within the lamp envelope along its axis the electrode filament(s) may be attached to an intermediate point along the strip part and the excess length of strip bent back to a suitable shape.

One form of electrode assembly in accordance with the present invention is shown in the accompanying drawing, and will now be described by way of example.

The drawing shows a perspective view of an electrode assembly mounted on a pinched foot-tube for sealing into the end of the tubular envelope of a fluorescent lamp 5 feet in length, and adapted to dissipate 80 watts in operation and to carry a discharge current of 0.85 amp.

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welded together. The nickel strips 7 constitute what have been termed the support conductors carrying the electrode within the lamp envelope, and these strips provide the anode members of the electrode assembly; the strips are bent over the ends 3, 4 of the electrode 2 so as to grip them firmly and the free ends 8 of the strips are bent so as each to extend in a direction approximately at right angles to the rest of the strip. The strips 7 are each of total length 20 mms., width 1.5 mms. and thickness 0.2 mms. and the total surface area of the two nickel strips together is about 130 square millimetres.

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